Asthma Research in ORD: An Overview

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Science Question

This research program addresses the following science questions (see Figure 1):

- What are the factors responsible for susceptibility and vulnerability to asthma, and who are the populations most affected?
- How do pollutant and allergens affect the incidence and severity of asthma?
- What are the underlying mechanisms?
- What are the best risk management strategies to reduce the burden of asthma?

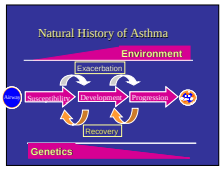

Figure 1. Factors affecting the development of asthma

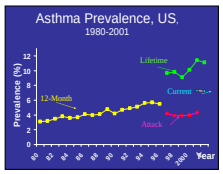

Figure 2. Asthma prevalence

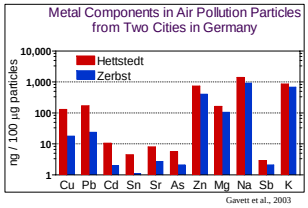

Figure 4. Differences in metal components in air pollution particles from two cities in Germany

Diesel PM Induces Airflow Obstruction in Mildly Allergic Mice

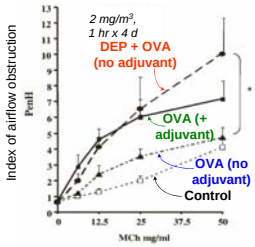

Figure 3.

- BALB/c mice were sensitized to ovalbumin (OVA) allergen alone (mild protocol) or with alum adjuvant.
- 2 weeks later, mice were exposed to saline, diesel exhaust particles (DEP), and/or OVA aerosols on 4 consecutive days. Mice were assessed next day. (Hao et al. 2003)

Results/Conclusions

- Asthmatic subjects are more sensitive to ozone exposure than healthy subjects
- DEP can make mildly allergic asthmatic subjects more susceptible to airflow obstruction (**Figure 3**)
- Metal-rich dusts increase allergic sensitization and severity of lung disease at challenge (**Figure 4**)
- Ozone can cause **new** cases of asthma in children
- The mold Stachybatrus can cause an allergic response in mice
- Intervention strategies can be successful at reducing allergens known to exacerbate asthma.
- For more detailed results see: "EPA's Asthma Research Program Accomplishments" <http://www.epa.gov/nheerl/publications/>

EPA's Niche in Air Pollution Respiratory Research

- Characterizing air pollution sources
- Determine the role of indoor bioaerosols (e.g., molds) in the onset and exacerbation of asthma
- Determining the role of air pollutants in the onset and exacerbation of asthma
- Characterizing risks posed by air pollutants (dose-response, threshold concentrations, etc)
- Developing cost-effective control strategies

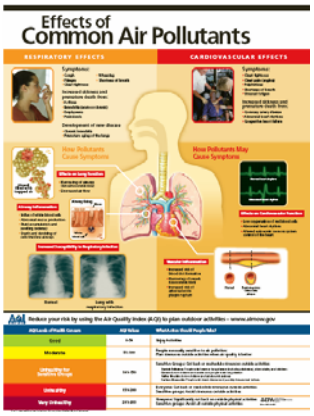

Figure 5. Medical poster for patient education www.airnow.gov (OAR)

Research Goals

- Identify which air pollutants and relevant concentrations may affect the incidence and severity of asthma
- Determine the factors associated with children's susceptibility to the development of asthma
- Determine susceptibility of asthmatic children to environmental triggers
- Determine the role of bioaerosols in causing and exacerbating asthma
- Determine the risk management strategies of mold

Background

In 2001, 20.3 million Americans (7.2% of U.S. pop.) had asthma, and 12 million had had an asthma attack in the previous year. In the same year 6.3 million (2.2% of U.S. pop.) were children. From 1980-1996 prevalence of asthma increased by 75% and in children the proportion grew by 160% (**Figure 2**). EPA's Office of Research and Development (ORD) has developed a targeted asthma research program, outlined by a peer-reviewed 2002 Asthma Research Strategy (U.S. EPA, 2002).

Methods/Approach

EPA's asthma program is driven by the ORD Asthma Research Strategy, and the general hypothesis that ***environmental factors influence the induction and exacerbation of asthma, and that these factors can be controlled***. ORD's multidisciplinary approach spans numerous scientific areas including exposure assessment, combustion engineering and chemistry, epidemiology, pulmonary medicine, laboratory animal science, mucosal immunology, airway physiology and molecular biology.

Impact and Outcomes

- The research provided the health basis for NAAQS for ozone and PM and risk communication.
- The data resulted in numerous peer-reviewed publications many of which have contributed significantly to a better understanding of the underlying mechanisms responsible for the causation and exacerbation of asthma
- ORD developed prevention and intervention techniques accepted and implemented by HUD,GSA and local health departments
- The use of ORD data in the IED/OAR has resulted in the development of a number of educational and popular mold documents
- Outreach activities in asthma include programs that support health messages for Air Quality Index (AQI) and educational materials (**Figure 5**).

Future Directions

- Relative role of the different combustion products applying computational toxicology models to predict these effects in ambient airsheds
- Impact of controlled technologies on the burden of asthma (e.g., fuel additives)
- Genetic polymorphism (heterogeneity) in response to environmental exposures
- Development innovative biochemical strategies to prevent environmentally-related asthma
- How does aging affect responsiveness to environmental chemicals?
- What is the impact of gestational and early life exposure to allergens and environmental chemicals on the development of asthma?